

SMD – MELF – Resistors automotive grade

Product : Metal Film Precision Resistor - SMDM Series

Size: 0102 / 0204/ 0207



official distributor of



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Metal Film Precision Resistor (SMDM Series)

► 1. Features

- AEC-Q200 Compliance
- Thin Film Technology
- Excellent overall stability
- Sn termination on Ni barrier layer
- Tight tolerance down to $\pm 0.1\%$
- Extremely low TCR down to ± 10 PPM/ $^{\circ}\text{C}$
- High power rating up to 1 Watts
- SMD enabled structure
- Lead-free and RoHS compliant



► 2. Applications

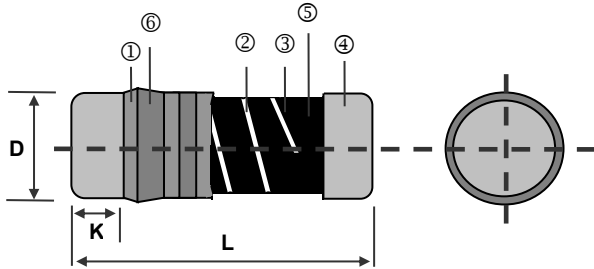
- Automotive
- Industrial
- Telecommunication
- Medical Equipment
- Measurement/Testing Equipment

► 3. Technical specifications

Description	SMDM0102			SMDM0204		SMDM0207	
Resistance range	1R ~ 1M; 0R			0R1 ~ 3M4; 0R		0R1 ~ 3M4; 0R	
Resistance tolerance	$\pm 5\%$; $\pm 1\%$, $\pm 0,5\%$; $\pm 0,25\%$; $\pm 0,1\%$						
Temperature coefficient	$\pm 100\text{ppm}/^{\circ}\text{C}$; $\pm 50\text{ppm}/^{\circ}\text{C}$ $\pm 25\text{ppm}/^{\circ}\text{C}$; $\pm 15\text{ppm}/^{\circ}\text{C}$			$\pm 100\text{ppm}/^{\circ}\text{C}$; $\pm 50\text{ppm}/^{\circ}\text{C}$ $\pm 25\text{ppm}/^{\circ}\text{C}$; $\pm 15\text{ppm}/^{\circ}\text{C}$; $\pm 10\text{ppm}/^{\circ}\text{C}$			
Operation mode	Standard	High power		Standard	High power	Standard	High power
Power rating P_{70}	1/8W	1/5W	0,3W	1/4W	2/5W	1/2W	1W
Operating Voltage U_{max}	150V	200V	200V	200V	200V	300V	350V
Operating temperature range	$-55^{\circ}\text{C} \sim +155^{\circ}\text{C}$						
Max. resistance change at P_{70} for resistance range max. after 1000h	$\leq 0,5\%$			$\leq 0,5\%$		$\leq 0,5\%$	

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4. Construction



①	Insulation Coating	④	Electrode Cap
②	Trimming Line	⑤	Resistor Layer
③	Ceramic Rod	⑥	Marking

5. Dimensions

Unit: mm

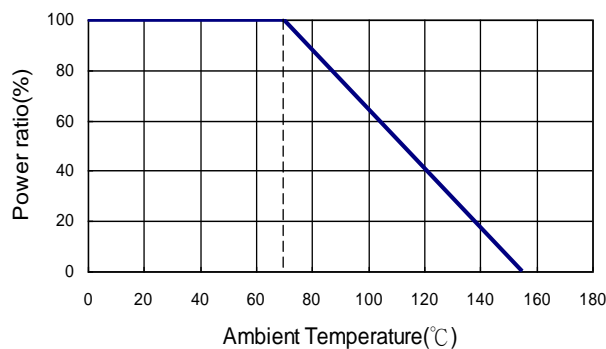
Type	L	ΦD	K min.	Weight (g) (1000pcs)	Packaging
					180mm (7")
SMDM0102	2.20±0.1	1.10±0.10	0.45	7.7	3,000EA
SMDM0204	3.50±0.2	1.40±0.15	0.8	18.7	3,000EA
SMDM0207	5.90±0.2	2.20±0.20	1.3	80.9	2,000EA

6. Part Numbering

SMDM	0204	D	T	D	V	1000A
Product Type	Dimensions (L×ΦD)	Resistance Tolerance	Packaging Code	TCR (PPM/°C)	Power Rating	Resistance
	0102: 2.2x1.1 0204: 3.5x1.4 0207: 5.9x2.2	B: ±0.1% C: ±0.25% D: ±0.5% F: ±1% J: ±5%	T: Taping Reel	B: ±10 N: ±15 C: ±25 D: ±50 E: ±100 - : No Specified	T: 1W U: 1/2W V: 1/4W G: 2/5W P: 1/5W W: 1/8W L: 0,3W	0010: 1Ω 0100: 10Ω 1000: 100Ω 2201: 2200Ω 1001: 1KΩ 1004: 1MΩ R0R0: 0Ω R050: 0.05Ω R100: 0.1Ω 22R1: 22.1Ω

** Letter "R" is a decimal point.

7. Derating Curve



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► 8. Standard Electrical Specifications

Item Type	Power Rating at 70°C	Operating Temp. Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range					TCR (PPM/°C)
					±0.1%	±0.25%	±0.5%	±1%	±5%	
0102	1/8W	-55 ~ +155°C	150V	300V	100Ω-56KΩ				-	±15
					100Ω-82KΩ		49Ω9-200KΩ	49Ω9-390KΩ	-	±25
	-				1Ω-1MΩ			±50		
	-				1Ω-1MΩ		±100			
	-				0Ω(<15mΩ)	-				
0204	1/4W		200V	400V	49Ω9-20KΩ				±10	
					10Ω-300KΩ				±15	
	10Ω-1MΩ				10Ω-3M4Ω	1Ω-3M4Ω	±25			
	10Ω-1MΩ				1Ω-3M4Ω	1Ω-3M4Ω	0.2Ω-3M4Ω	±50		
	-				0.1Ω-1MΩ		±100			
0207	1/2W	300V	600V	49Ω9-20KΩ				±10		
				10Ω-300KΩ				±15		
	10Ω-1MΩ			10Ω-3M4Ω	1Ω-3M4Ω	±25				
	10Ω-1MΩ			1Ω-1MΩ	1Ω-3M4Ω	0.2Ω-3M4Ω	±50			
	-			0.1Ω-1MΩ		±100				
Jumper:4A	-				0Ω(<15mΩ)	-				

► 8.1. High Power Rating Electrical Specifications

Item Type	Power Rating at 70°C	Operating Temp. Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range					TCR (PPM/°C)
					±0.1%	±0.25%	±0.5%	±1%	±5%	
0102	1/5W	-55 ~ +155°C	200V	400V	100Ω-56KΩ				-	±15
					100Ω-82KΩ		49Ω9-200KΩ	49Ω9-390KΩ	-	±25
	-				1Ω-1MΩ			±50		
	-				1Ω-1MΩ		±100			
0204	2/5W		200V	400V	10Ω-300KΩ				±15	
					10Ω-1MΩ		10Ω-3M4Ω	1Ω-3M4Ω	±25	
	10Ω-1MΩ				1Ω-1MΩ	1Ω-3M4Ω	0.2Ω-3M4Ω	±50		
	-				0.1Ω-1MΩ		±100			
0207	1W		350V	700V	10Ω-300KΩ				±15	
					10Ω-1MΩ		10Ω-3M4Ω	1Ω-3M4Ω	±25	
	10Ω-1MΩ	1Ω-1MΩ			1Ω-3M4Ω	0.2Ω-3M4Ω	±50			
	-				0.1Ω-1MΩ		±100			

Operating Voltage= $\sqrt{P \cdot R}$ or Max. Operating Voltage listed above, whichever is lower.

Overload Voltage= $2.5 \cdot \sqrt{P \cdot R}$ or Max. Overload Voltage listed above, whichever is lower.

RCWV(Rated Continuous Working Voltage)= $\sqrt{P \cdot R}$ or Max. Operating Voltage whichever is lower.

Better Tolerances and better TC upon request.

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► 9. Environmental Characteristics

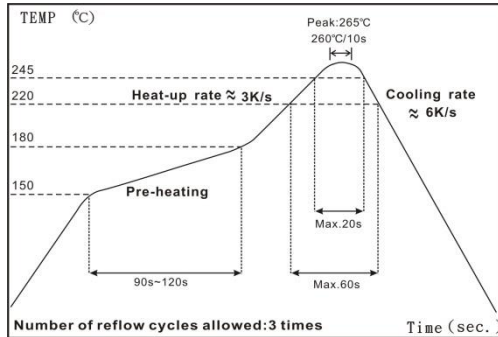
Item	Requirement		Test Method
	5% and below	Jumper	
Temperature Coefficient of Resistance (T.C.R.)	As Spec		JIS-C-5201-1 4.8 IEC-60115-1 4.8 At 25°C/-55°C and 25°C/+125°C, 25°C is the reference temperature
Short Time Overload	10Ω-270KΩ: ±(0.1%+0.05Ω) <10Ω & >270KΩ: ±(0.15%+0.05Ω) 0102: ±(0.15%+0.05Ω)	<15mΩ	JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2.5 or Max. overload voltage for 5 seconds
Insulation Resistance	≥10G		JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. overload voltage for 1 minute
Endurance	10Ω-270KΩ: ±(0.25%+0.05Ω) <10Ω & >270KΩ: ±(0.5%+0.05Ω) 0102: ±(0.5%+0.05Ω)	<15mΩ	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 MIL-STD-202 Method 108 70±2°C, Max. working voltage for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Biased Humidity	10Ω-270KΩ: ±(0.5%+0.05Ω) <10Ω & >270KΩ: ±(1%+0.05Ω) 0102: ±(2%+0.05Ω)	<15mΩ	MIL-STD-202 Method 103 1000 hrs 85°C/85%RH 10% of operating power.
High Temperature Exposure	10Ω-270KΩ: ±(0.25%+0.05Ω) <10Ω & >270KΩ: ±(1%+0.05Ω) 0102: ±(1%+0.05Ω)	<15mΩ	MIL-STD-202 Method 108 at +155°C for 1000 hrs
Board Flex	10Ω-270KΩ: ±(0.1%+0.05Ω) <10Ω & >270KΩ: ±(0.5%+0.05Ω) 0102: ±(0.5%+0.05Ω)	<15mΩ	AEC-Q200-005 Bending once for 60 seconds with 2mm
Solderability	95% min. coverage		JIS-C-5201-1 4.17 IEC-60115-1 4.17 J-STD-002 245±5°C for 3 seconds
Resistance to Soldering Heat	10Ω-270KΩ: ±(0.1%+0.05Ω) <10Ω & >270KΩ: ±(0.25%+0.05Ω) 0102: ±(0.25%+0.05Ω)	<15mΩ	MIL-STD-202 Method 210 260±5°C for 10 seconds
Voltage Proof	No breakdown or flashover		JIS-C-5201-1 4.7 IEC-60115-1 4.7 1.42 times RCWV (RMS) for 1 minute
Leaching	Individual leaching area ≤5% Total leaching area ≤ 10%		JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260±5°C for 30 seconds
Temperature Cycling	10Ω-270KΩ: ±(0.25%+0.05Ω) <10Ω & >270KΩ: ±(0.5%+0.05Ω) 0102: ±(1%+0.05Ω)	<15mΩ	JESD22 Method JA-104 -55°C to +125°C, 1000 cycles
Mechanical Shock	± (0.25%+0.05Ω)	<15mΩ	MIL-STD-202 Method 213 Wave Form: Tolerance for half sine shock pulse. Peak value is 100g's. Normal duration (D) is 6.
Vibration	±(0.5%+0.05Ω)	<15mΩ	MIL-STD-202 Method 204 5 g's for 20 min., 12 cycles each of 3 orientations, 10-2000 Hz
ESD	±(0.5%+0.05Ω)	<15mΩ	AEC-Q200-002 Human body, 2KV
Resistance to Solvents	No visible damage on appearance and marking.		MIL-STD-202 Method 215 Add Aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents.
Terminal Strength	No broken		AEC-Q200-006 Force of 1.8kg for 60 seconds.
Flammability	No ignition of the tissue paper or scorching or the pinewood board		UL-94 V-0 or V-1 are acceptable. Electrical test not required.

■ RCWV(Rated Continuous Working Voltage)=√(P*R) or Max. Operating Voltage whichever is lower.

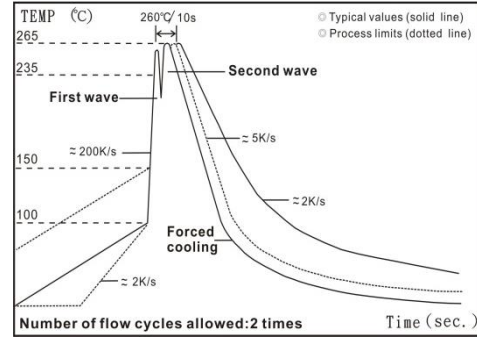
■ Storage Temperature: 15 - 28°C; Humidity < 80%RH

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10. Soldering Condition



IR Reflow Soldering



Wave Soldering (Flow Soldering)

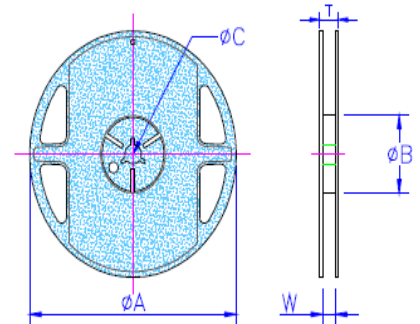
- (1) Time of IR reflow soldering at maximum temperature point 260°C : 10s
- (2) Time of wave soldering at maximum temperature point 260°C : 10s
- (3) Time of soldering iron at maximum temperature point 410°C : 5s

11. Packaging

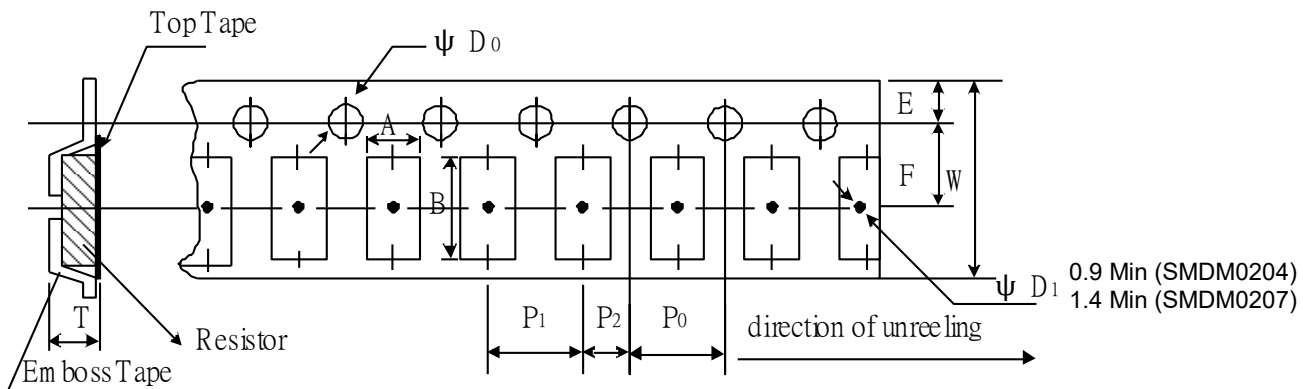
Packaging Quantity & Reel Specifications

Unit :mm

Type	ΦA	ΦB	ΦC	W	T	Emboss Plastic Tape (EA)
SMDM0102	178.5 \pm 1.5	60.0 \pm 1.0	13.0 \pm 0.2	9.0 \pm 0.5	12.5 \pm 0.5	3,000
SMDM0204	178.5 \pm 1.5	60.0 \pm 1.0	13.0 \pm 0.2	9.0 \pm 0.5	12.5 \pm 0.5	3,000
SMDM0207	178.5 \pm 1.5	60.0 \pm 1.0	13.0 \pm 0.5	13.0 \pm 0.5	15.5 \pm 0.5	2,000



Emboss Plastic Tape Specifications



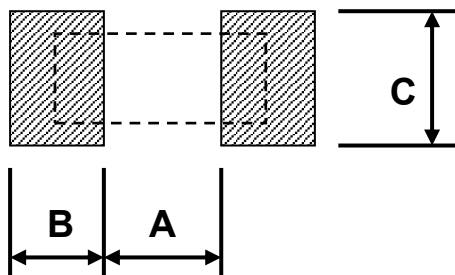
Unit: mm

Type	A	B	W	E	F	P ₀	P ₁	P ₂	ΦD_0	T
SMDM0102	1.30 \pm 0.10	2.40 \pm 0.10	8.0 \pm 0.10	1.75 \pm 0.10	3.50 \pm 0.05	4.00 \pm 0.10	4.00 \pm 0.10	2.00 \pm 0.05	1.50 \pm 0.10	1.50 \pm 0.10
SMDM0204	1.55 \pm 0.10	3.65 \pm 0.10	8.0 \pm 0.10	1.75 \pm 0.10	3.50 \pm 0.05	4.00 \pm 0.10	4.00 \pm 0.10	2.00 \pm 0.05	1.50 \pm 0.10	1.80 \pm 0.10
SMDM0207	2.40 \pm 0.10	6.15 \pm 0.10	12.0 \pm 0.10	1.75 \pm 0.10	5.50 \pm 0.05	4.00 \pm 0.10	4.00 \pm 0.10	2.00 \pm 0.05	1.50 \pm 0.10	2.70 \pm 0.10

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▶ 12. Recommend Land Pattern

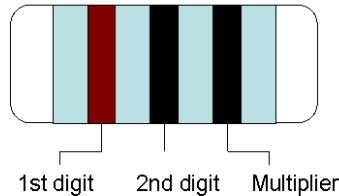
Unit: mm



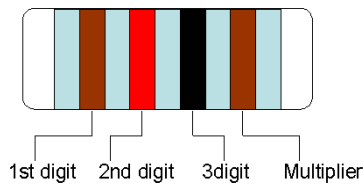
Type	A	B	C
SMDM0102	1.0	0.8	1.5
SMDM0204	1.6	1.2	1.6
SMDM0207	3.0	1.7	2.4

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► 13. Marking & Resistance Tolerance



±5%	E-24	1.0	1.1	1.2	1.3	1.5	1.6	1.8	2.0	2.2	2.4	2.7	3.0	3.3	3.6	3.9	4.3	4.7	5.1	5.6	6.2	6.8	7.5	8.2	9.1
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±1%	E-96	1.00	1.02	1.05	1.07	1.10	1.13	1.15	1.18	1.21	1.24	1.27	1.30	1.33	1.37	1.40	1.43	1.47	1.50	1.54	1.58	1.62	1.65	1.69	1.74
		1.78	1.82	1.87	1.91	1.96	2.00	2.05	2.10	2.15	2.21	2.26	2.32	2.37	2.43	2.49	2.55	2.61	2.67	2.74	2.80	2.87	2.94	3.01	3.09
		3.16	3.24	3.32	3.40	3.48	3.57	3.65	3.74	3.83	3.92	4.02	4.12	4.22	4.32	4.42	4.53	4.64	4.75	4.87	4.99	5.11	5.23	5.36	5.49
		5.62	5.76	5.90	6.04	6.19	6.34	6.49	6.65	6.81	6.98	7.15	7.32	7.50	7.68	7.87	8.06	8.25	8.45	8.66	8.87	9.09	9.31	9.53	9.76
±0.5% ±0.25% ±0.1%	E-192	10.0	10.1	10.2	10.4	10.5	10.6	10.7	10.9	11.0	11.1	11.3	11.4	11.5	11.7	11.8	12.0	12.1	12.3	12.4	12.6	12.7	12.9	13.0	13.2
		13.3	13.5	13.7	13.8	14.0	14.2	14.3	14.5	14.7	14.9	15.0	15.2	15.4	15.6	15.8	16.0	16.2	16.4	16.5	16.7	16.9	17.2	17.4	17.6
		17.8	18.0	18.2	18.4	18.7	18.9	19.1	19.3	19.6	19.8	20.0	20.3	20.5	20.8	21.0	21.3	21.5	21.8	22.1	22.3	22.6	22.9	23.2	23.4
		23.7	24.0	24.3	24.6	24.9	25.2	25.5	25.8	26.1	26.4	26.7	27.1	27.4	27.7	28.0	28.4	28.7	29.1	29.4	29.8	30.1	30.5	30.9	31.2
		31.6	32.0	32.4	32.8	33.2	33.6	34.0	34.4	34.8	35.2	35.7	36.1	36.5	37.0	37.4	37.9	38.3	38.8	39.2	39.7	40.2	40.7	41.2	41.7
		42.2	42.7	43.2	43.7	44.2	44.8	45.3	45.9	46.4	47.0	47.5	48.1	48.7	49.3	49.9	50.5	51.1	51.7	52.3	53.0	53.6	54.2	54.9	55.6
		56.2	56.9	57.6	58.3	59.0	59.7	60.4	61.2	61.9	62.6	63.4	64.2	64.9	65.7	66.5	67.3	68.1	69.0	69.8	70.6	71.5	72.3	73.2	74.1
		75.0	75.9	76.8	77.7	78.7	79.6	80.6	81.6	82.5	83.5	84.5	85.6	86.6	87.6	88.7	89.8	90.9	92.0	93.1	94.2	95.3	96.5	97.6	98.8

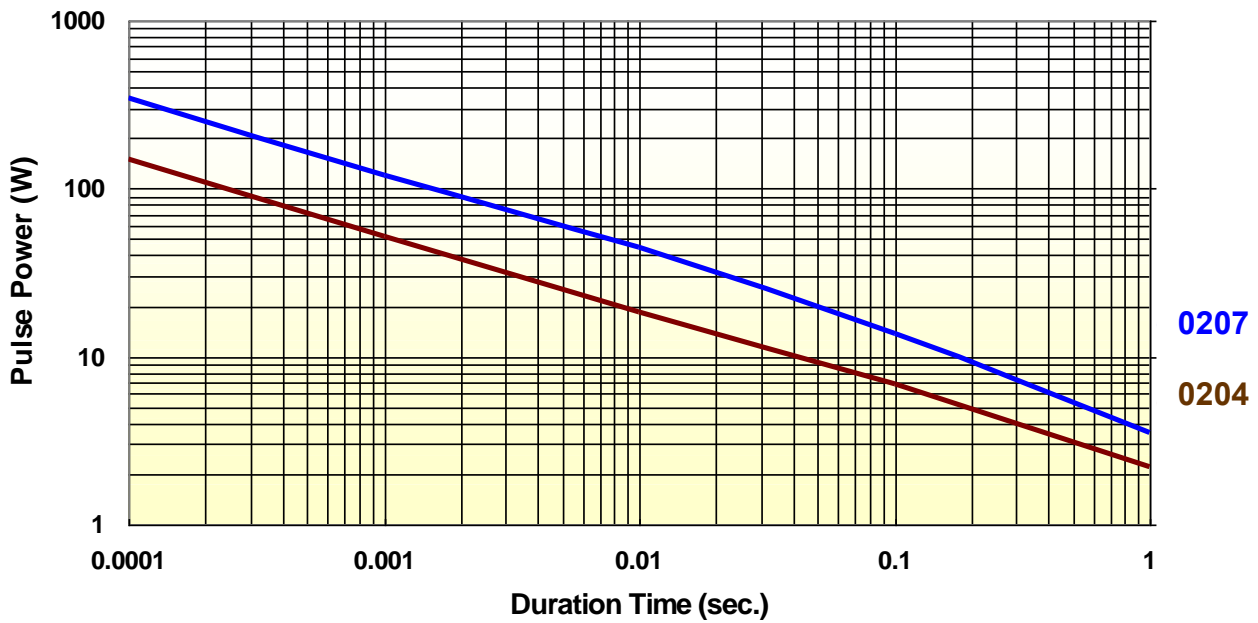
Color	Digit	Multiplier
Silver	-	10 ⁻²
Gold	-	10 ⁻¹
Black	0	10 ⁰
Brown	1	10 ¹
Red	2	10 ²
Orange	3	10 ³
Yellow	4	10 ⁴
Green	5	10 ⁵
Blue	6	10 ⁶
Violet	7	10 ⁷
Grey	8	10 ⁸
White	9	10 ⁹

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▶ 14. Pulse withstanding capacity

The single impulse graph is the result of 50 impulses of rectangular shape applied at one-minute intervals. The limit of acceptance was a shift in resistance of less than 1% from the initial value. The power applied was subject to the restrictions of the maximum permissible impulse voltage graph shown.

SMDM Series Single Pulse(100 Ohm)

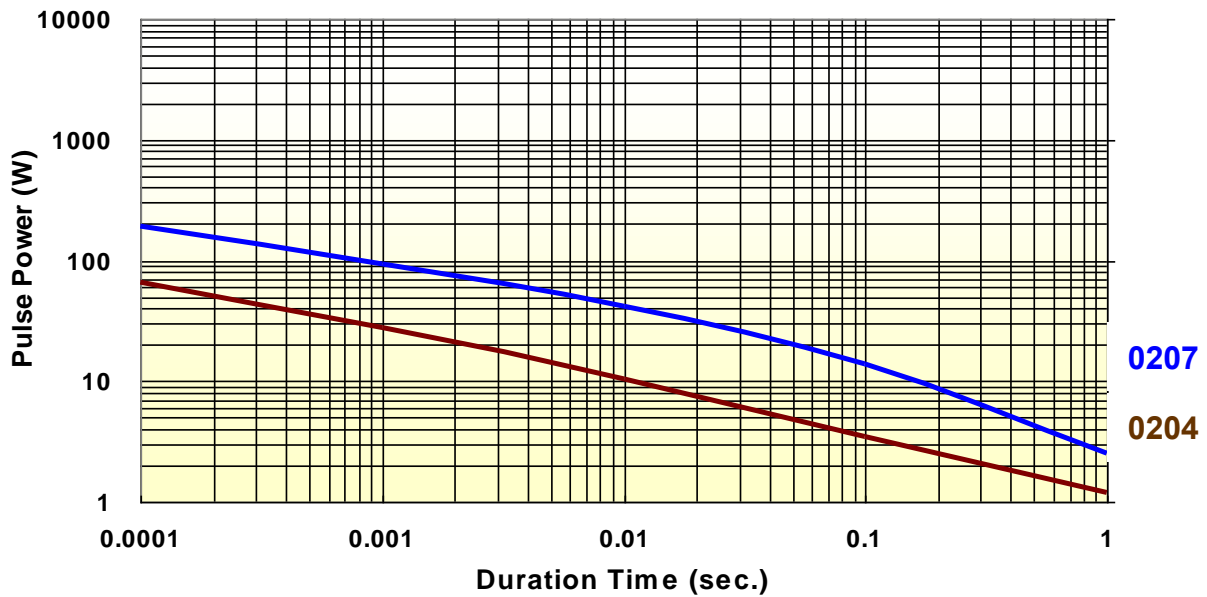


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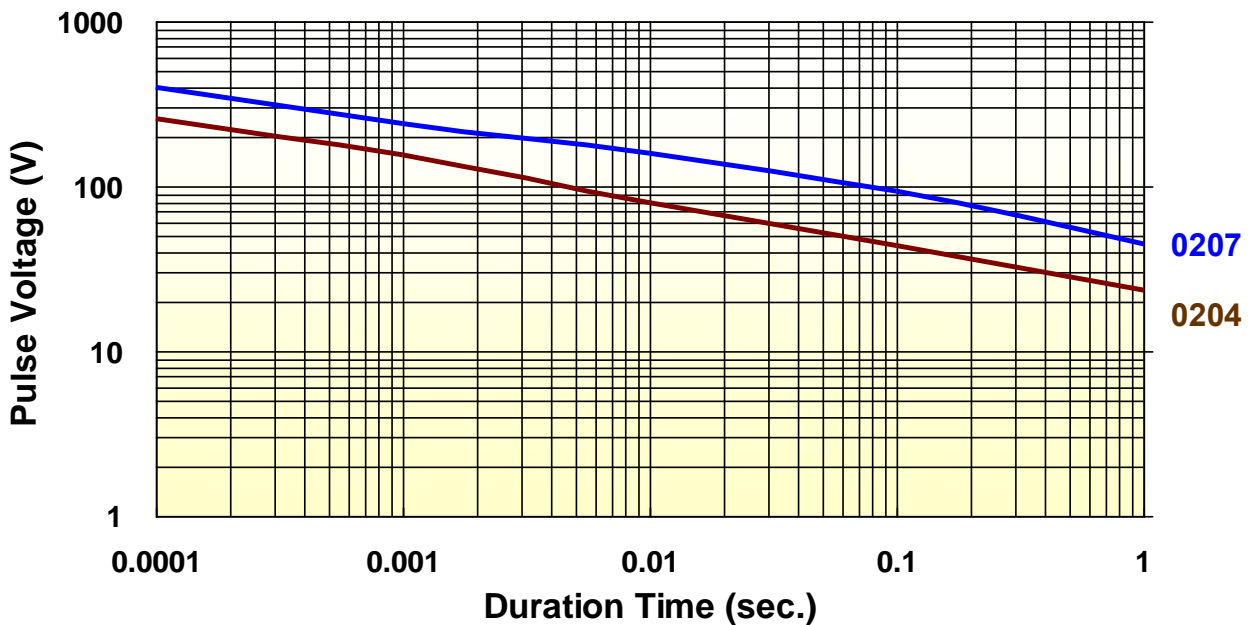
▶ 15. Continuous Pulse

The continuous load graph was obtained by applying repetitive rectangular pulses where the pulse period was adjusted so that the average power dissipated in the resistor was equal to its rated power at 70°C. Again the limit of acceptance was a shift in resistance of less than 1% from the initial value.

SMDM Series Continuous Pulse(100 Ohm)



SMDM Series Pulse Voltage(100 Ohm)



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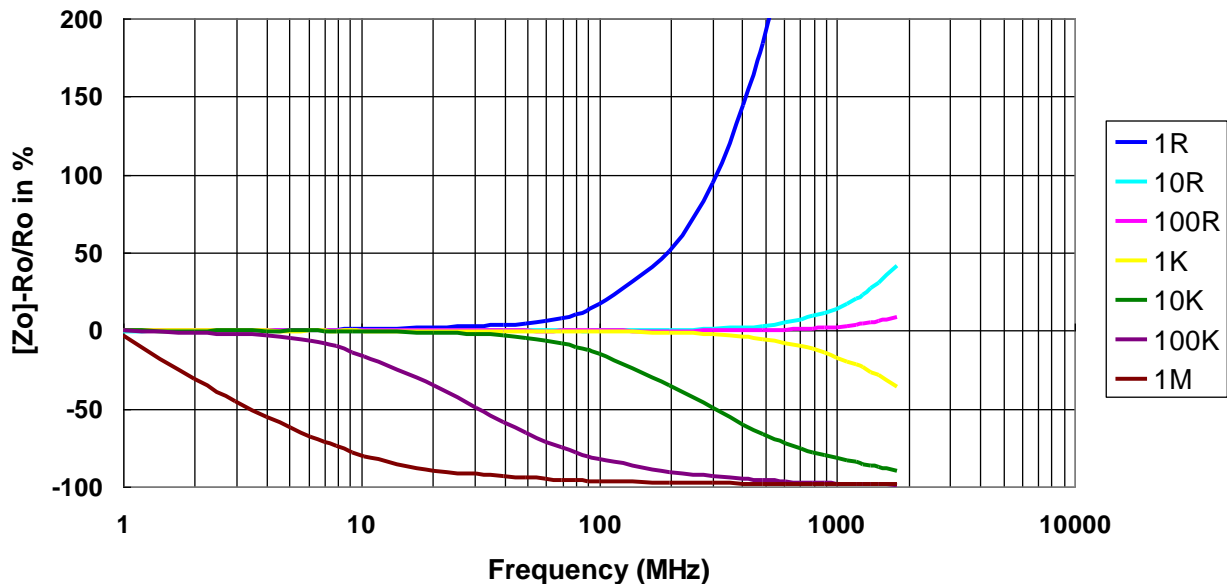
▶ 16. Frequency behavior

Resistors are designed to function according to ohmic laws. This is basically true of resistors for frequencies up to 100kHz. At higher frequencies, there is an additional contribution to the impedance by an ideal resistor switched in series with a coil and both switched parallel to a capacitor. The values of the capacitance and inductance are mainly determined by the dimensions of the terminations and the conductive path length.

The environment surrounding components has a large influence on the behavior of the component on the printed-circuit board.

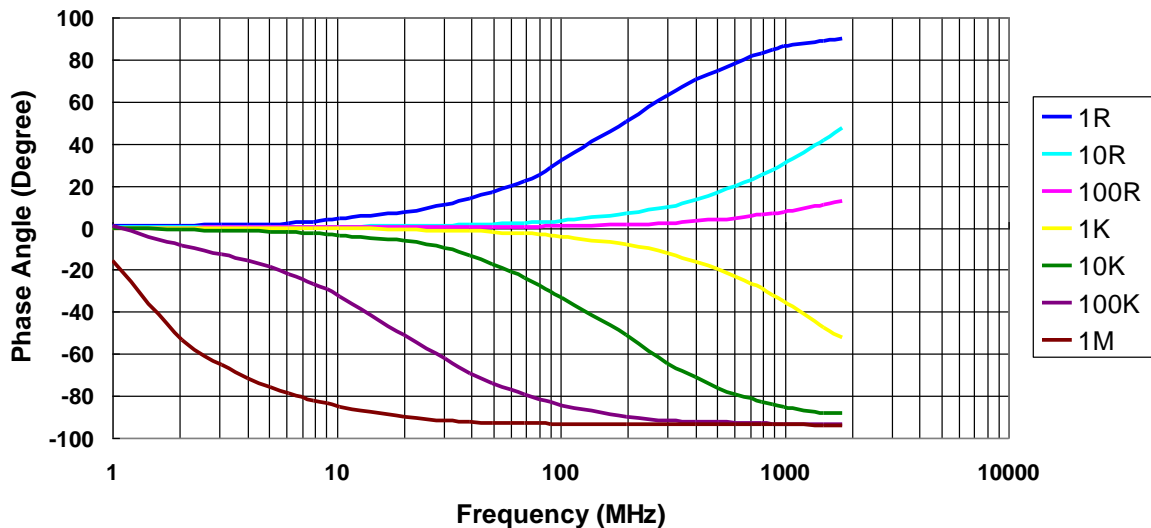
Frequency vs. Impedance

SMDM 0204



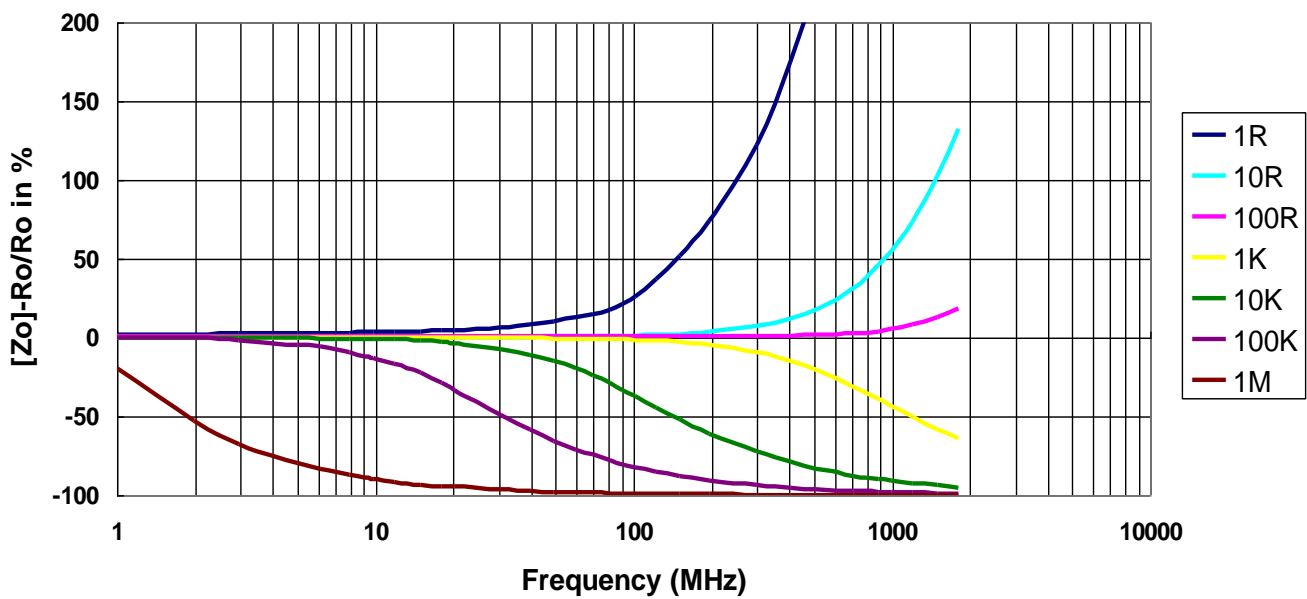
Frequency vs. Phase Angle

SMDM 0204

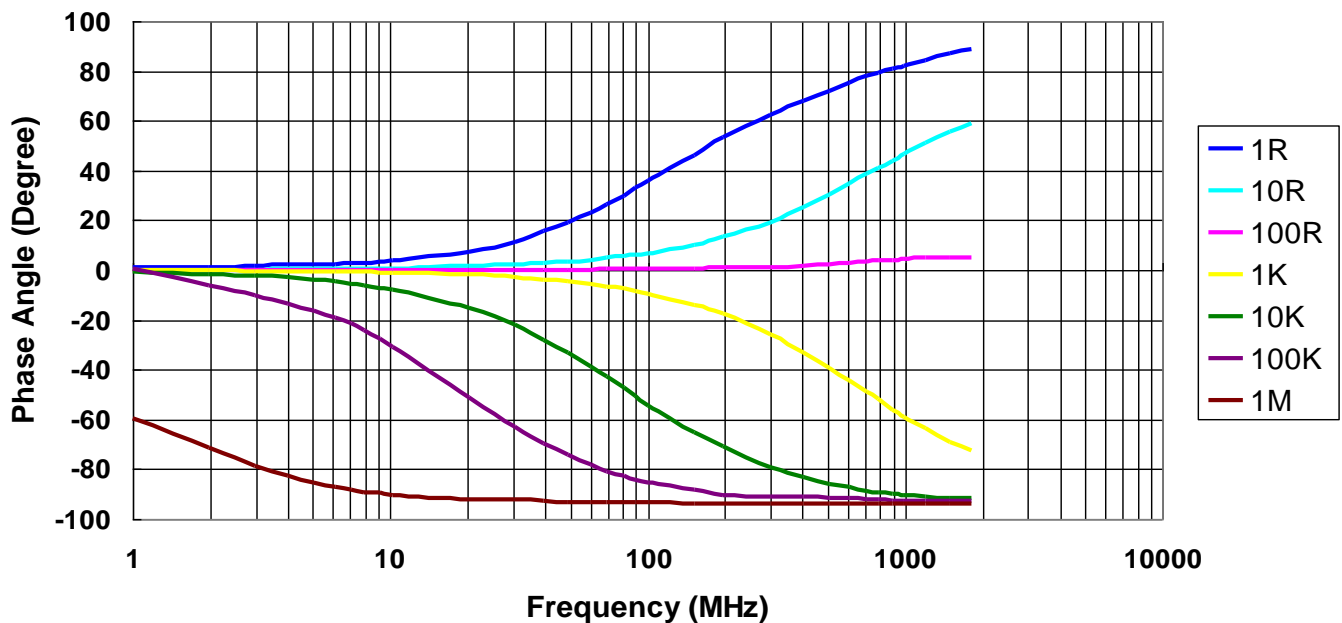


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Frequency vs. Impedance
SMDM 0207



Frequency vs. Phase Angle
SMDM 0207

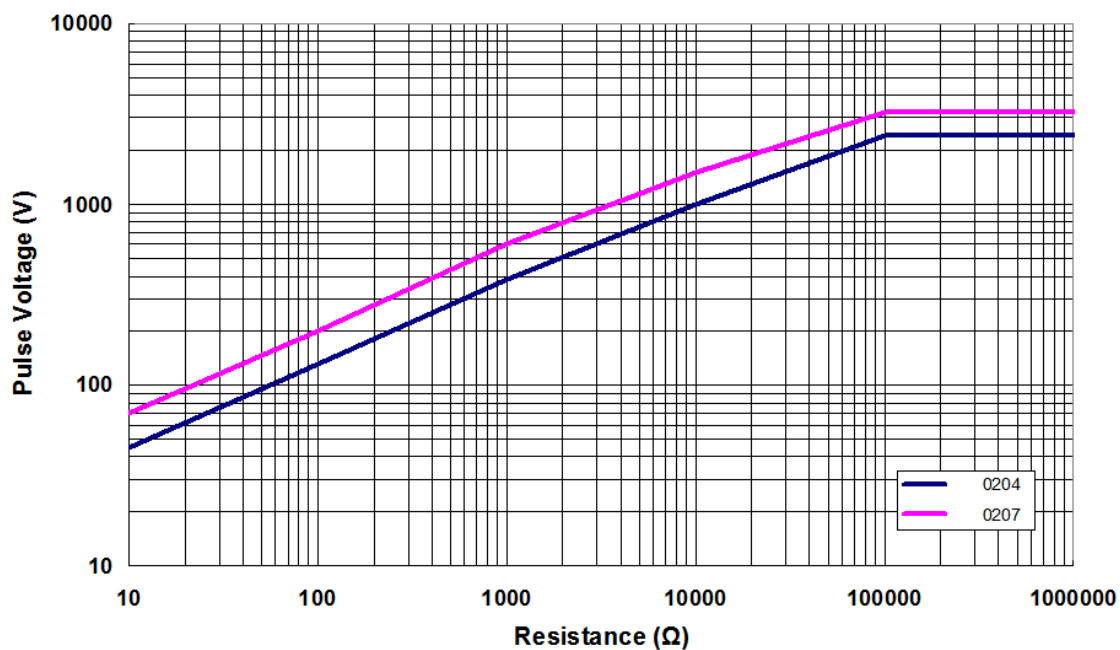


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▶ 17. Lightning Surge

Resistors are tested in accordance with IEC 60 115-1 using both 1.2/50us and 10/700us pulse shapes. The limit of acceptance is a shift in resistance of less than 0.5% from the initial value.

10/700 μ s Lightning Surge



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1.2/50 μ s Lightning Surge

